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Mineral metabolism in pregnant dairy goats

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Introduction

The successful of pregnancy is provided by important physiological changes in the maternal body (Bauman e Currie, 1980; Bell and Ehrhardt, 2000; Scheaffer et al., 2001). These changes were studied mains in the last days of pregnancy were the highest fetal growing is seen with metabolism of energy and protein (Battaglia and Meschia, 1978; Bauman and Currie, 1980).

Studies on mineral metabolism during pregnancy were performed with sheep and cows (Braithwaite et al., 1970; Suttle, 2010). In prepartum goats and days of lactation the bone resorption increases to meet the fetus and the requirements for milk production (Liesegang et al., 2006).

Minerals perform essential functions in the organism and the animal's requirement depends on the physiological state (NRC, 2007; Suttle, 2010). However there is little information about mineral metabolism during the pregnancy in goats, especially for macro minerals. Therefore the objective of this study is to check the changes that occur in the Ca, P, Mg, Na and K metabolism in Oberhasli and Saanen goats with single and twin pregnancy.

Material and methods

The experimental animals were from a group of multiparous, non-lactating and pregnant goats. The goats from two breed (Oberhasli and Saanen) were randomly assigned in different ages of pregnancy (80, 110 and 140 days) according to the type of pregnancy (single or twin). Three goats were used (49,5 kg ± 7,6 BW) in each treatment in a completely randomized design with a factorial arrangement 3x2x2. In the beginning of the experiment three animals non pregnant from each breed were separated and used as reference animals. The experimental procedures of this study were approved by the ethics commission of São Paulo State University-UNESP, Jaboticabal campus, São Paulo, Brazil. At 80, 110 and 140 days of gestation the goats were slaughtered. The femur from right leg was removed to determine the mineral density and chemical composition. The whole body without pregnant uterus and mammary gland were ground, homogenized and with drawing a sample that was frozen. These samples were freeze-dried for 72 h to determine the DM content and ground

in a ball mill. Before milling of the femur bone was done the x-ray image to determine the mineral density. Digestibility assays were performed at the 50, 80, 110 and 140 days of pregnancy. Blood samples were collected at 1, 35, 50, 65, 80, 95, 110, 125 and 140 days of gestation. To determination of mineral contends in the body, bone, food, orts, faeces and urine samples were subjected to nitro-perchloric digestion (AOAC, 1990; method number 935.13). The Ca and Mg were determined by atomic absorption, the K and Na were determined by atomic emission and the P was determined by colorimetric method (AOAC, 1990; method number 965.17). The bone mineral density analysis of proximal and distal epiphysis and diaphysis were performed on X-ray scanned images from the right femur taken together with a 12-step Al (aluminum alloy 6063, ABNT) as described by Araújo et al. (2011). The serum concentration of Ca, P and Mg were determined using commercial kits (LABTEST, Lagoa Santa MG, Brazil). The serum K, Na and ionized calcium Ca were determined using a electrolyte analyzer (model ROCHE 9180 Electrolyte Analyzer). With the results were calculated the bone mineral density retention and the mineral retention in the maternal body and in the femur. The retention data, digestibility and blood metabolites were analyzed as mixed models using the MIXED procedure of SAS (version 9.2).

Results and discussion

The minerals retention was lower in the Saanen maternal body ($P < 0.01$). Saanen goats had higher apparent absorption of K ($P < 0.05$), lower losses in faeces and urine of Ca, K and higher of Mg and Na ($P < 0.01$). This shows that different genotypes have different mineral metabolism. Differences between the milk composition and milk production in these two breeds have been reported by Biochard et al. (1989). In all of the animals the Ca, P and Mg in maternal body retention decreased ($P < 0.01$) with advancing gestation. It was found higher retention of sodium in the body of goats with twin pregnancy. The femur of Saanen goats had larger concentrations of Ca, P and Mg. With the exception of Ca, the femur mineral concentration changed with pregnancy advancing, with mobilization to 80 days and deposition to 110 days. To meet the requirements of the transformations that occur in the maternal body in early pregnancy, possibly occurred in the femur bone resorption. However minerals were stored in the body of the animal, since the maternal body retention was greater and the excretion losses were lower in this stage of pregnancy. Accordingly it was observed that the mineral density of the femur diaphysis was lower in 80 days and higher in 110 days of pregnancy ($P < 0.01$). The concentrations of serum Ca increased 0.5 mg / dl between the first and 80th day of gestation. However, after 110 days of pregnancy serum concentrations of Ca decreased significantly. This is probably in consequence of the fetal demand and loss of body minerals that occur during this period (NRC, 2007, Braithwaite et al., 1970). Serum concentrations

of P, Mg and ionized Ca unchanged with the pregnancy advancing. The serum potassium concentrations decreased with advancing gestation, possibly because the role this mineral plays in the exchange of chlorine in the respiratory process. At 140 days of gestation the animals decreased the total dry matter intake and increased total water consumption ($P < 0.05$). The apparent absorption coefficient of Ca was higher at 140 days, possibly due a body adjustment to the lower Ca intake. In accordance to Liesegang et al. (2006) and Braithwaite et al. (1970) the amount of Ca absorbed during late pregnancy could be insufficient to meet the demands in this stage. Similarly there was a decrease in urinary and fecal losses of P, Mg and Nafrom110 days of gestation. The number of fetuses is not decisive in the mother metabolic changes during the pregnancy. The maternal metabolism changes with the advance of pregnancy and it is different between the breeds studied.

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